Effective Atomic Number of Ge-doped and Al-doped Optical Fibres for Radiation Dosimetry Purposes.

Abstract

Optical fibers have been demonstrated by this group to show promising thermoluminescence (TL) properties with respect to ionizing radiation. Present research has focused on commercially produced single-mode telecommunication optical fibers manufactured by CorActive (Canada) either in the form of SiO2 optical fibers doped with either Ge or Al. Control of radiation dose is essential in performing an experiment in a biomedical context. One important aspect in this is the tissue equivalence of the dosimetric material. Mixtures or compounds that are similar in their radiation interaction characteristics to the soft tissue, bone or any other body constituents can be identified for this purpose. Effective atomic number of a medium prescribes its detection efficiency and tissue equivalence. To obtain the effective atomic number of the doped fibers, SEM (Scanning Electron Microscope) and EDXRS (Energy Dispersive X-ray Spectroscopy) analysis was performed to acquire the composition of the element inside the optical fibers. From our investigation, the value of Zeff is in the range of 11.5-13.4 and 11.7-13.7 for Ge-doped and Al-doped respectively (value of Zeff in soft tissue is 7.5 and Zeff for bone is between 11.6-13.8). Given that Ge- and Al-doped optical fibers are not soft-tissue equivalent, the assessment of dose deposition in such media would need to be corrected for an expected over-response. However, the value of Zeff is within the range of bone, making the optical fiber a strong candidate for use in skeletal radiation dosimetry.

Keyword: Ge-doped optical fibres